Stoller
Grand Junction Office established 1959

GJO-2004-573-TAC

C4218
Log Data Report

Borehole Information:

Borehole: C4218			**Site:** 216-U-8 Crib		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Dry		**GWL Date:**	02/02/2004
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
Not Available	Not Available	Jan. 2004	Not Available	50	Push Hole

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	0.2	6 5/8	5 5/8	1/2	0.2	50

Borehole Notes:

This push-hole is located at the nine o'clock position west of the 216-U-8 Crib boundary. Zero reference is the ground surface. The logging engineer measured a sample of casing located in a lay-down area next to the borehole. Outside casing diameter was measured using a caliper and a steel tape. Measurements were rounded to the nearest 1/16 in. Using an acoustic depth device, depth-to-bottom measured 49.5 ft from top-of-casing.

Logging Equipment Information:

Logging System:	Gamma 1E		**Type:** SGLS (70%) 34TP40587A
Calibration Date:	01/2004	**Calibration Reference:**	GJO-2004-568-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2E		**Type:** SGLS (70%) 34TP40587A
Calibration Date:	03/2003	**Calibration Reference:**	GJO-2003-430-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	**1**	**2**	**3 / Repeat**	**4**	**5**
Date	02/02/04	02/02/04	02/02/04	02/11/04	02/11/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	48.85	48.0	38.5	48.9	48.5
Finish Depth (ft)	48.85	0.5	33.5	48.9	15.5
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	N/A[3]	1.0	1.0	N/A	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	BE064CAB	BE064CAB	BE064CAB	AE083CAB	AE083CAB

Log Run	1	2	3 / Repeat	4	5
Start File	BE064000	BE064001	BE064050	AE085000	AE085001
Finish File	BE064000	BE064049	BE064055	AE085000	AE085034
Post-Verification	BE065CAA	BE065CAA	BE065CAA	AE085CAA	AE085CAA
Depth Return Error (in.)	N/A	-0.5	0	N/A	0
Comments		No fine-gain adjustment.	Repeat section.	Sonde tip is touching bottom of borehole.	No fine-gain adjustment.

Log Run	6 / Repeat	7			
Date	02/12/04	02/12/04			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	38.5	16.5			
Finish Depth (ft)	33.5	0.5			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AE086CAB	AE086CAB			
Start File	AE086000	AE086006			
Finish File	AE086005	AE086022			
Post-Verification	AE086CAA	AE086CAA			
Depth Return Error (in)	N/A	0			
Comments	Repeat section.	No fine-gain adjustment.			

Logging Operation Notes:

The borehole was logged with both Gamma 2E and Gamma 1E. Zero reference was ground surface. Logging was performed with a centralizer installed on the sonde. Because the Gamma 2E system performance failed to meet the acceptance criteria, the borehole was relogged with Gamma 1E. Pre- and post-survey verification measurements for the Gamma 2E SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 82. On 02/04/2004, peak counts per second (cps) for ^{232}Th (2614 keV) were below acceptance criteria for verification files BE064CAB and BE065CAA. The borehole was relogged with Gamma 1E after evaluation of Gamma 2E calibration data indicated a significant loss of efficiency at high energy so that the system could not be calibrated. Pre- and post-survey verification measurements for the Gamma 1E SGLS employed the Amersham KUT verifier with serial number 118. As instructed by Rick McCain, files BE64000 and AE085000 are from total depth with the logging cable under tension and the sonde tip touching the bottom plug. Files BE64000 and AE085000 were collected at the maximum depth reached by the sonde measured from the ground surface to the crystal's center or 0.77 ft from the tip. After collecting one spectrum, the sonde was moved to the nearest 0.5-ft interval and logging continued as prescribed in the logging procedure.

Analysis Notes:

Analyst:	Sobczyk	Date:	2/16/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

Gamma 1E pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria except for spectra AE086CAB and AE086CAA. The photopeak counts per second at 2614.5 keV for AE086CAB and AE086CAA were below

the acceptance criteria. The peak counts per second (cps) at the 609-keV and 1461-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectrum for each day were between 1.1 percent higher and 0.6 percent lower at the end of the day. Examinations of spectra indicate that the recorded peak counts per second have slightly reduced calculated concentrations above 1800 keV, and the spectra are provisionally accepted.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G1EJan04.xls). Zero reference was the ground surface. Based on the field measurements, the casing configuration was assumed as one string of 6-in. casing with a thickness of 1/2 in. to 48.9 ft (total logging depth). Dead time corrections were applied when dead time surpassed 10 percent. A water correction was not required.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{238}U and ^{137}Cs were the man-made radionuclides detected in this borehole. ^{137}Cs was detected at 1.5 ft with a concentration near the MDL (0.3 pCi/g). After examination of the individual spectrum, it was determined that there is no evidence of a photopeak at 662 keV. The reported peak is probably the result of statistical fluctuation. ^{238}U, based on the 1001-keV photopeak, was detected at 37.5 ft with a concentration of 34 pCi/g. Traces of ^{238}U were apparent at 38.5 and 39.5 ft, based on the 1001-keV photopeak.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV and for ^{238}U at 1001 keV. Apparent ^{40}K (1461 keV) concentrations were approximately 1 pCi/g higher on the repeat log than the original log.

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[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

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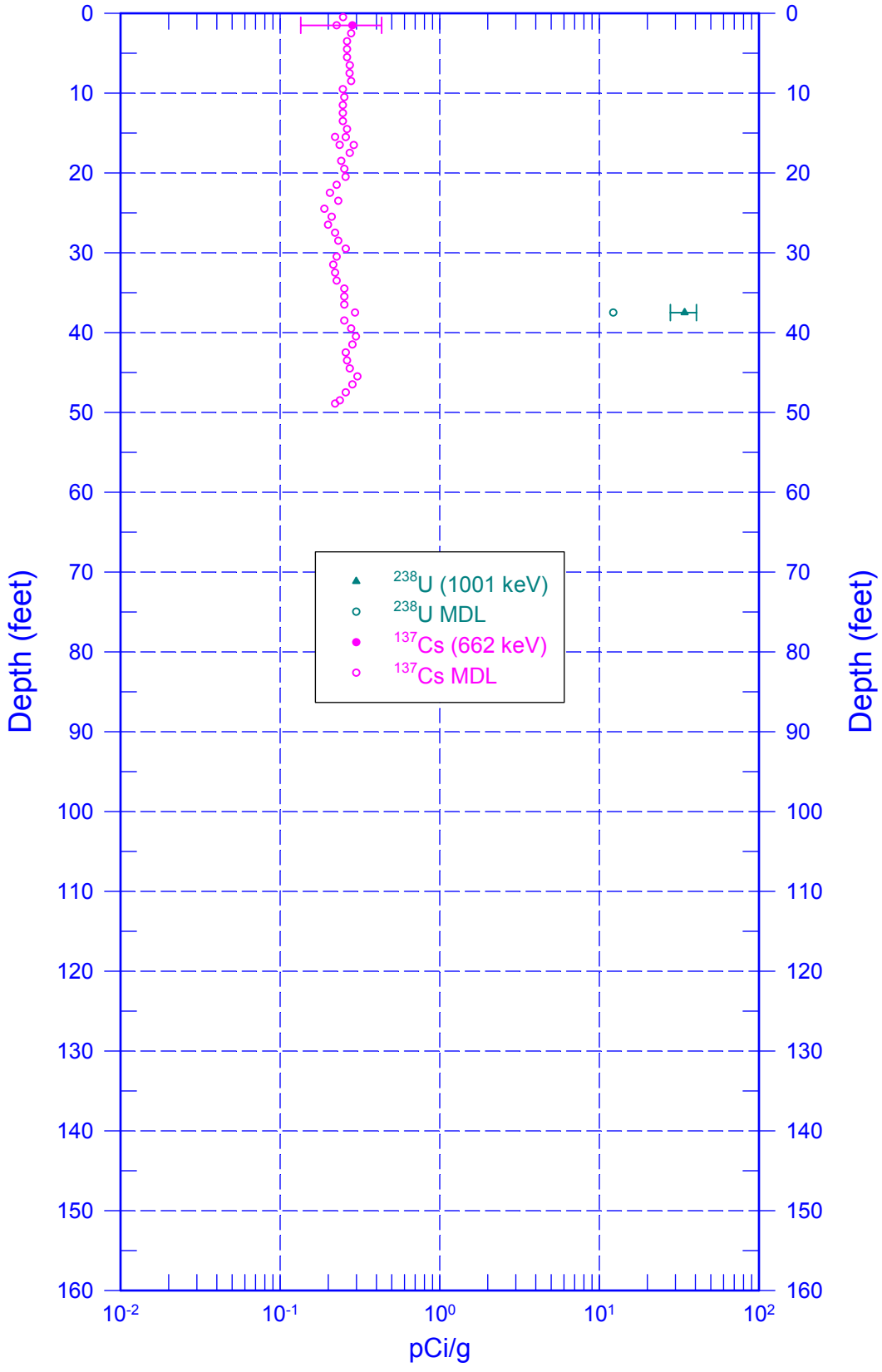
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Last Logging Run
2/12/2004

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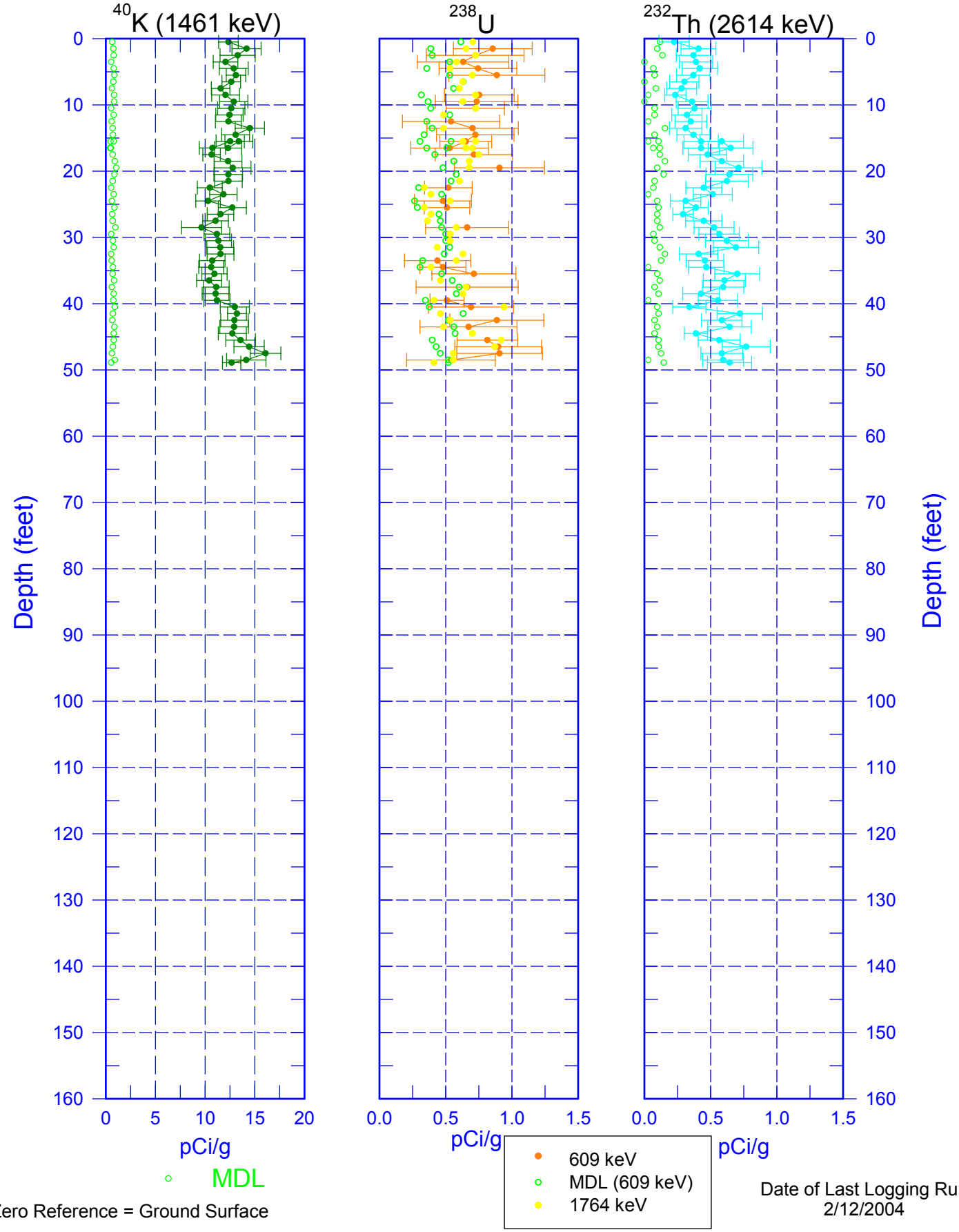
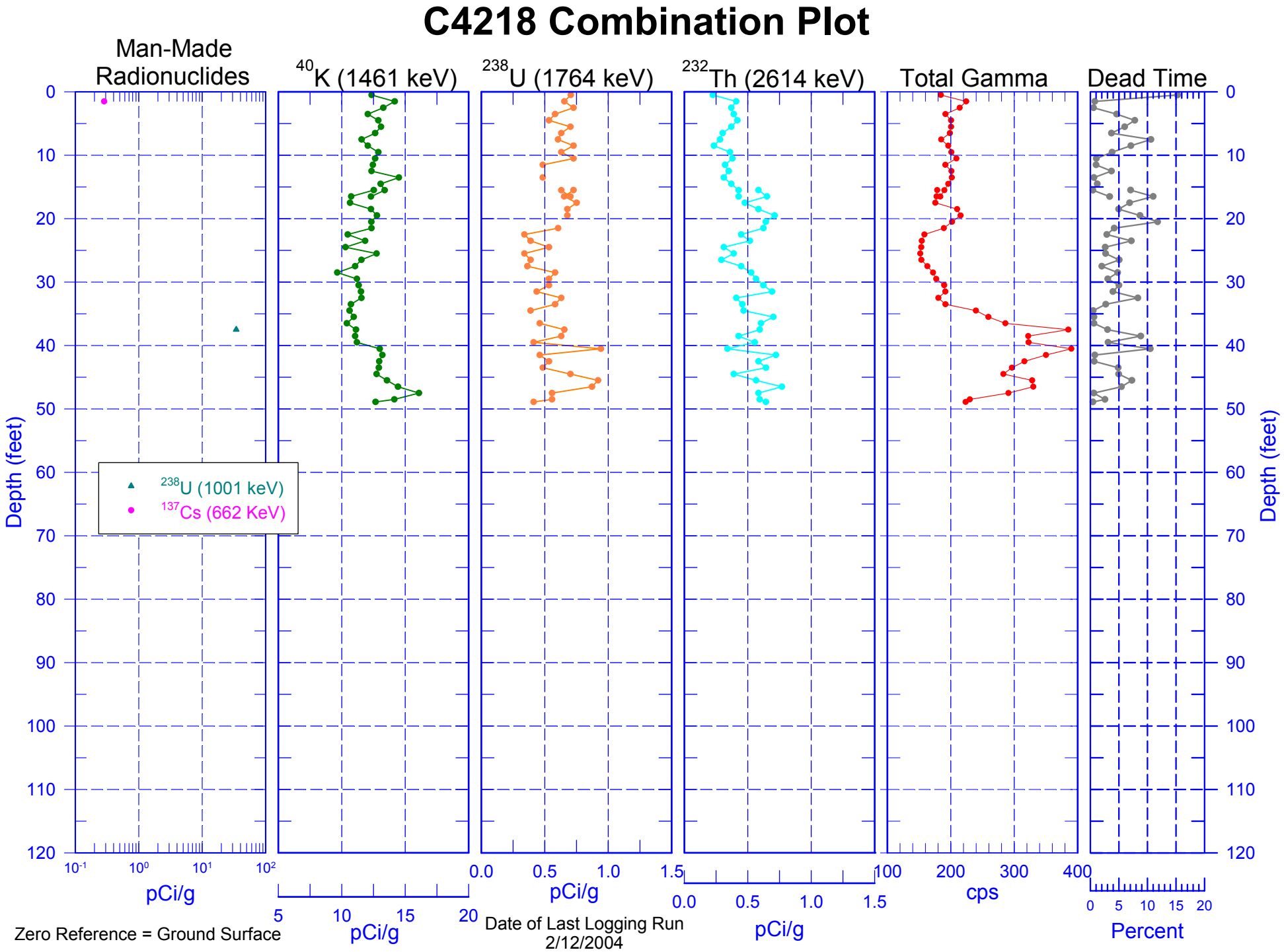
Natural Gamma Logs

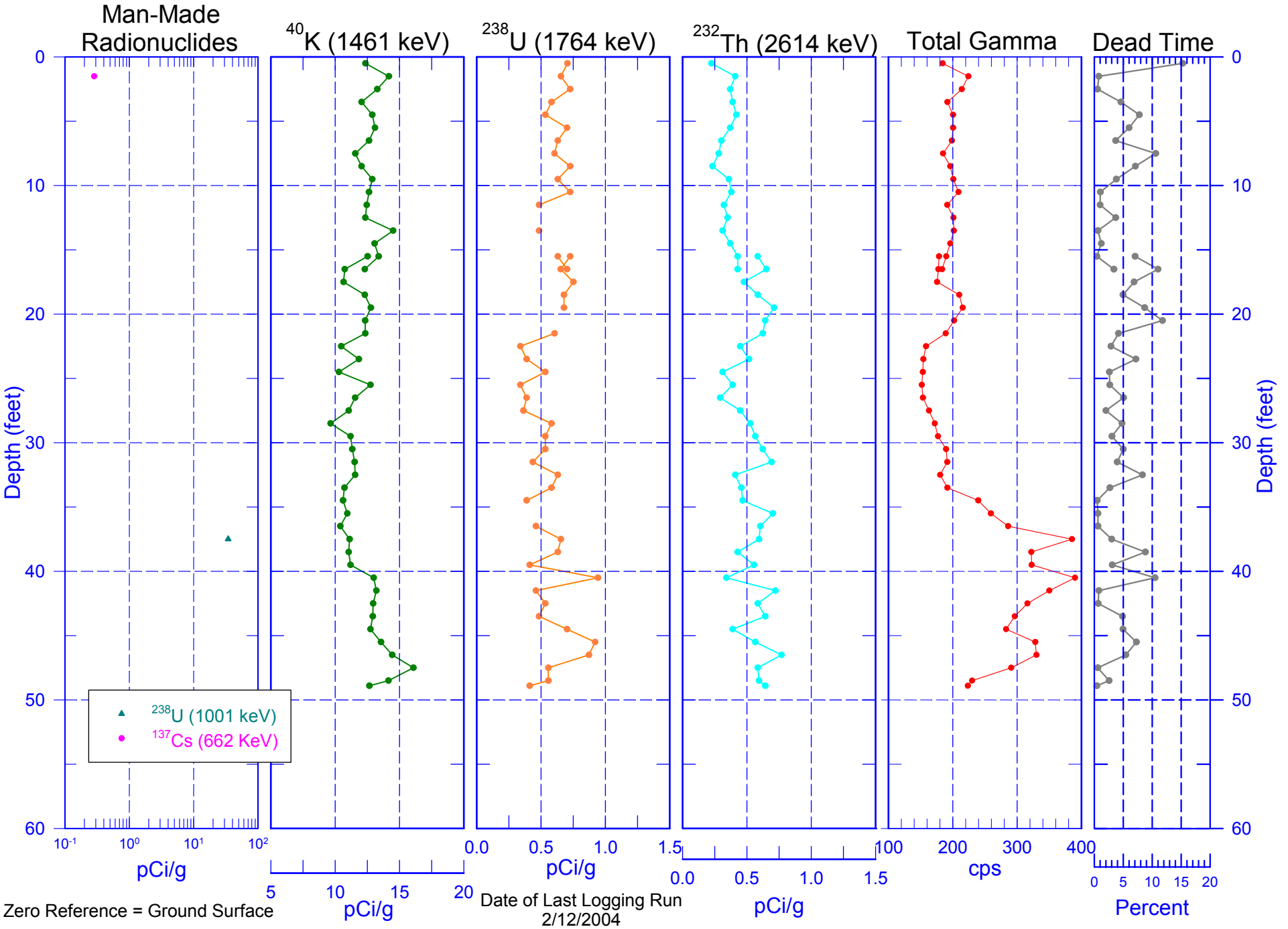


Zero Reference = Ground Surface

Date of Last Logging Run
2/12/2004


C4218 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Depth (feet)
238U (1001 keV)
137Cs (662 KeV)
pCi/g
cps
Percent
Zero Reference = Ground Surface
Date of Last Logging Run
2/12/2004

C4218 Combination Plot



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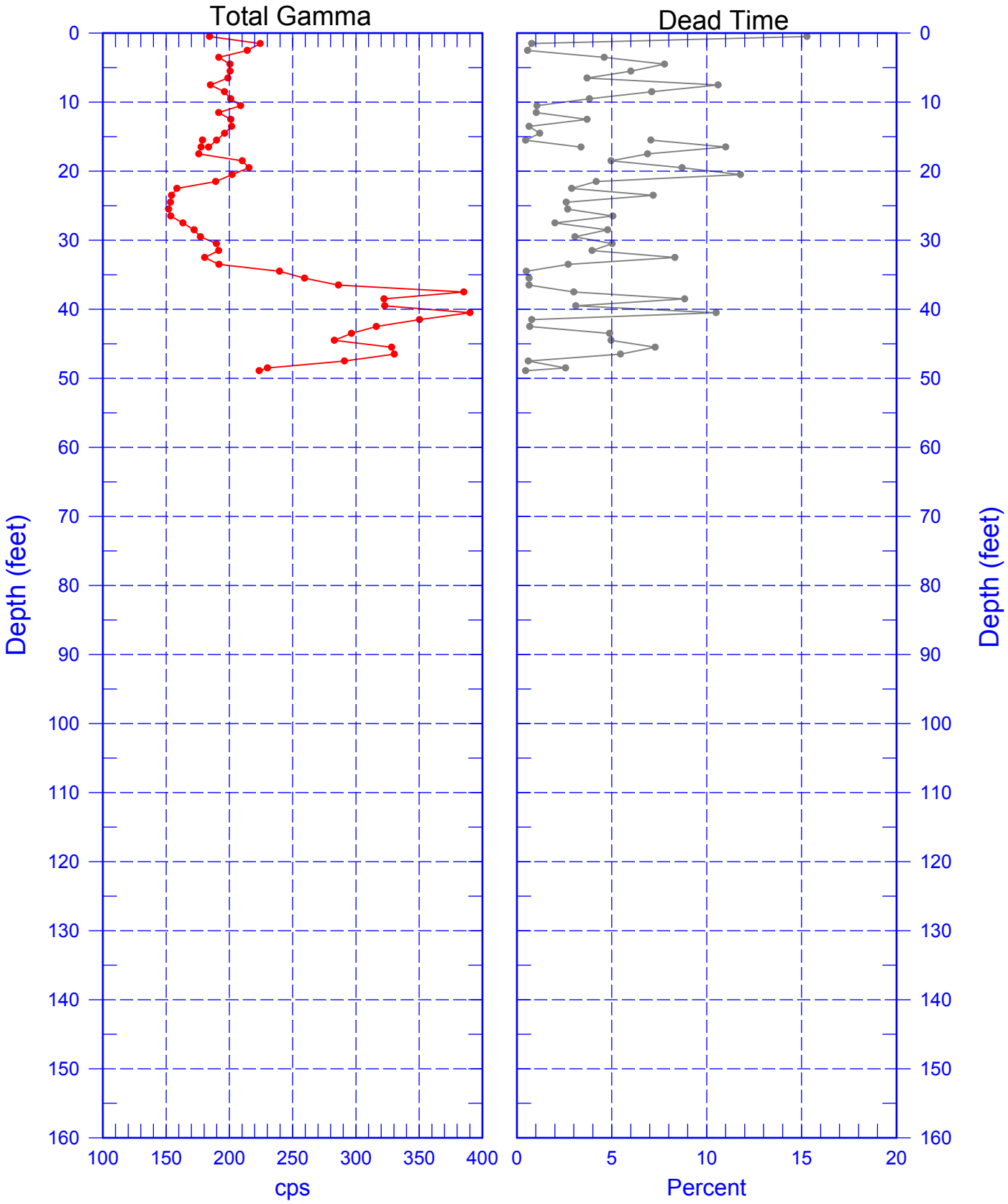
Total Gamma & Dead Time



Zero Reference = Ground Surface
Date of Last Logging Run
2/12/2004

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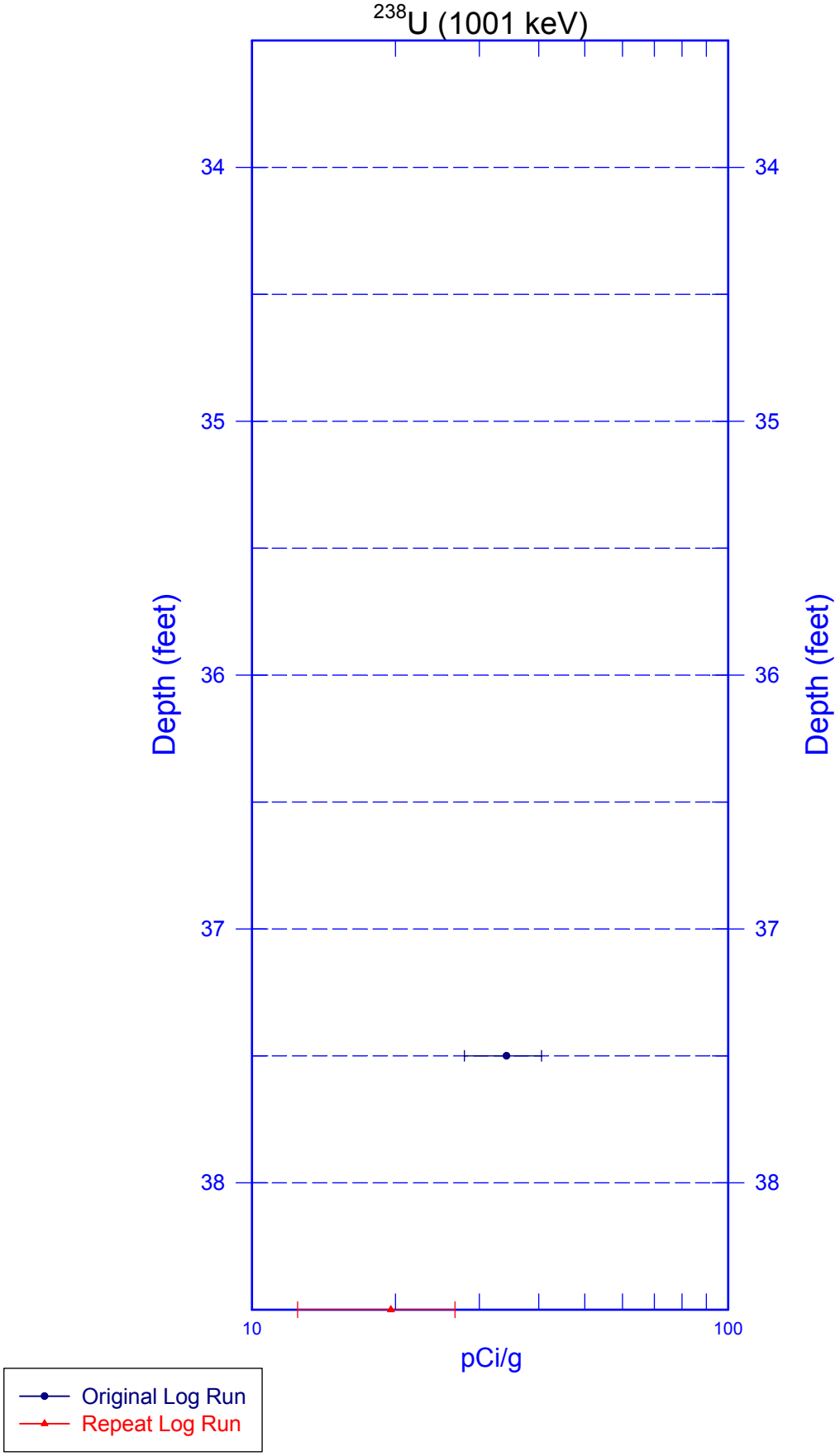
Rerun of Man-Made Radionuclides



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Rerun of Natural Gamma Logs (33.5 to 38.5 ft)